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(19)

(54) IMPROVEMENTS IN AND RELATING TO DRILLING TOOLS

(71) We, COMPAGNIE FRANCAISE DES PETROLES a French Corporate Body of 5, rue Michel-Ange, Paris 16e, France,

do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:-

The present invention relates to drilling tools and especially to high output drilling tools of the type with set-in or moulded cutters carrying stepped blocks, preferably diamond-covered and designed to destroy the drill-cores during formation and increase the output.

Numerous types of tools which comprise means intended to remove the drill-cores being formed are known. A large number of these permit the drill-core to develop over a certain length so that it can then be destroyed more conveniently.

Thus there may be mentioned, amongst the numerous devices for attacking a drill-core, those tools which comprise, at the centre, a passage of relatively large length compared to the total height of the tool, terminating, at the level at which the debris is removed, in a punch which is conical and does not rotate relative to the drill-core, the purpose of the punch being to cause the drill-core to break up when it comes into contact with the punch.

In spite of the advantages which such a tool offers, its use can cause certain difficulties, depending on the rocks encountered, due to abrupt breaks, causing the danger of choking which is the more troublesome the faster is the rate of advance of the tool, and the larger, relatively, are the sizes of the pieces of drill-core.

According to the present invention there is provided a drilling tool comprising a rotatable annular body provided with cutting means spaced circumferentially thereabout and defining an annular leading cutting surface such that a central core will be formed in use of said tool, and central drilling means provided in the interior space of said annular body and fixed to said body for breaking up the core, wherein said central drilling means has the form of a cone arranged with the apex thereof directed towards said leading cutting surface and such that, in use, said cone will have a drilling and a punching effect on the core.

The body of the tool may be provided with a passage for drilling sludge, the passage being arranged in an axial region of the body and opening adjacent the base of the cone so that sludge from the passage will flow over the cone to be discharged at the periphery of the body after it has passed over said leading cutting surface thereof.

The cone may be provided with a diamond at the apex thereof and the apex of the cone is preferably axially spaced from said leading cutting surface by a distance less than the axial extent of the part of said body provided with said cutting means.

Advantageously said apex of said cone is located adjacent said leading cutting surface and the internal surface of said body defining the interior space is provided with cutting means adjacent said cone.

The invention will be more fully understood from the following description of an embodiment thereof, given by way of example only, with reference to the accompanying drawings.

In the drawings:

Figure 1 is a schematic representation, in elevation and in axial cross-section, of an embodiment of a drilling tool according to the invention;

Figure 2 is a schematic plan view of the end of the tool of Figure 1; and

Figure 3 is an elevational view of two peripheral cutters of the tool of Figure 1.

While the invention is applicable to all types of drilling tools in which rotation of

the tool causes the formation of a drill-core which it is desired to destroy so that only debris of small size results, Figure 1 shows a very high output tool 1 to which the invention is particularly applicable.

The tool 1 comprises a rotatable annular body centred on the axis of rotation of the tool and provided with cutting means spaced circumferentially thereabout and defining a leading annular cutting surface 13 surrounding a central recess in which a cone 2 is provided for drilling the drill core formed by the annular cutting surface 13. The cone 2 can be produced, and incorporated into the tool, by any known technique. It can thus be moulded or set-in, and can be produced by simple sintering with or without infiltration. The cutting edges on the surface of the cone 2 are shown schematically by the profile 4, though the purpose of this line is only to act as a reminder that the cone 2 is a drilling cone, of which the nature and structure depend on the nature of the ground which is to be drilled. Thus, the cone 2 may comprise a diamond-dust concretion or can have diamonds set in over all or parts of its surface, which surface may optionally comprise cutters into which diamonds or a diamond-dust concretion are incorporated.

Preferably, the point of the cone 2 carries a diamond 5, whether the cone is a cone with cutters or the cone with set-in diamonds shown in Figure 2. Orifices for sludge coming from passages such as passage 11 are located at the level of the base of the cone 2, so that the sludge flushes the whole of the surface of the cone 2 and of the inner active part of the tool, and then flows beyond the leading cutting surface 13 of the tool and rises to the surface after passing over the peripheral cutters 14 and 15 of the tool. In this embodiment, the cone 2 is cut away at 6 on one side of the axis 7, so as to leave a free space 8 opposite attacking teeth 9 of the opposite cutter 10, communicating with passage 11 to facilitate the flow of the sludge.

The apex of the cone, with its diamond 5, is located on the axis 7 of the tool and of the drill-core which is being formed. In this way, the base of the drill-core, which extends from the end 13 of the tool to the diamond 5, and which is already under less pressure than the ground below it as a result of the lateral and frontal attack of the edges of the drilling cutters 9, terminates in a zone 16 which is under intense decompression due to the attack of the internal drilling cutters 9 and the cutting surface 4 of the cone 2. This decompression is the greater, the more the cone 2 in this region presses on the pivot diamond 5, facilitating, through a punching action on the central part of the drill-core, the work of the other diamonds and of the edges of the surfaces 4, 9 and 17.

It is self evident that, depending on the type of tool used, the level of the cone diamond 5 can vary relative to the levels of the attacking cutters, but the cone diamond should at all times remain at a level which is sufficiently close to the leading surface 13 of the tool that the length of the drill-core never exceeds the height of the active part of the tool, i.e. the height over which the sets of cutting surfaces of the tool extend.

It will be noted that, in the embodiment described, broad zones 18 have been provided without cutters near the leading surface 13 of the tool, so as to provide a large free volume for debris and sludge. Thus, the ends of the cutters such as 10, 19, 20 and 21 are at the level of the surface 13, whilst the ends of the cutters such as 22 are at a level 25, which is itself higher than the level of the ends 26 and 27 of the cutters 23 and 24. This staggering furthermore results in staggering of the levels of the cutting edges of consecutive cutters, as can be seen by considering, for example, the edges 28, 26 and 29 as well as the peripheral cutters 14.

The cutting surfaces 30 and 31, of different levels of cutters, have a slope which makes it easy to remove the decompressed debris after it has passed over the cutting edges 32. Equally, a certain rake angle 36 is provided on the front faces relative to the direction of rotation of the cutters. These features, combined with the peripheral passages, such as those formed between the cutters and the sides 35 of the tool, contribute to increasing the total output of the tool. The attacking cone 2, as well as other parts of the body of the tool, can contain set-in diamonds, diamond-dust concretions or pellets of tungsten carbide or of any other abrasion-resistant metal carbide.

There is thus provided a particularly efficient tool for carrying out rapid drilling to a very great depth, without having to lift the tool out. The drilling tool is provided with means for attacking the drill-core, wherein the attack takes place by means of a drilling cone located in the central part of the tool, so that the drill-core exhibits, at its apex, a conical cavity formed by rotation of the central attack cone of the tool. Additionally, to assist the removal of debris including that formed in the attack zone external to the central zone, drilling sludge is caused to converge in the central zone and to be discharged solely downstream from the central attack cone. In this way, flushing appropriate to the small size of the attack elements of the central cone is achieved, regardless of the type of central drilling cone used. Where a diamond is provided at the apex of the cone, the diamond serves as a pivot for the drilling cone and assists the breaking up of the rock into small pieces by a punching action, the cutting and/or abra-

sion being effected by cutting elements distributed over the surface of the cone surface.

Experience has shown that the speed of advance achieved can be increased without danger of graphitisation of the diamond, since the latter has a surface velocity of zero and is copiously swept by the sludge.

Furthermore, the breaking up of the drill-core into small pieces under the action of the diamond pivot is facilitated by the decompression which takes place at the peripheral parts of the drill-core because of the conventional attack of this periphery by cutting elements on the internal surface of the tool body.

WHAT WE CLAIM IS:-

1. A drilling tool comprising a rotatable annular body provided with cutting means spaced circumferentially thereabout and defining an annular leading cutting surface such that a central core will be formed in use of said tool, and central drilling means provided in the interior space of said annular body and fixed to said body for breaking up the core, wherein said central drilling means has the form of a cone arranged with the apex thereof directed towards said leading cutting surface and such that, in use, said cone will have a drilling and a punching effect on the core.

2. A tool as claimed in claim 1, including a passage in said body for drilling sludge, said passage being arranged in an axial region of said body and opening adjacent the base of said cone for distributing sludge thereover.

3. A tool as claimed in either claim 1 or claim 2, including a diamond in the apex of said cone and located on the axis of said body.

4. A tool as claimed in any one of the preceding claims, wherein the apex of said cone is axially spaced from said leading cutting surface of said body by a distance which is less than the axial extent of the part of said body provided with said cutting means.

5. A tool as claimed in any one of the preceding claims, wherein the apex of said cone is located adjacent said leading cutting surface of said body and said body is provided with cutting means on the internal surface defining said interior space and adjacent said cone.

6. A tool as claimed in any one of the preceding claims, wherein a recess is provided at the base of said cone for assisting passage of sludge thereform to the periphery of said body.

7. A tool as claimed in any one of the preceding claims, wherein said cone forms an integral part of said body and is incorporated therein by moulding.

8. A tool as claimed in any one of claims 1 to 6, wherein said cone is incorporated in the body of the tool by metallurgical means.

9. A tool as claimed in any one of claims 1 to 6, wherein said cone is set in said body.

10. A tool as claimed in claim 3 or any one of claims 4 to 9 when dependent on claim 3, wherein the surface of said cone comprises cutting diamonds distributed around said apex diamond.

11. A tool as claimed in any one of claims 3 to 9, where the surface of said cone comprises pellets of abrasion-resistant material.

12. A tool as claimed in any one of the preceding claims, wherein said cutting means comprises a staggered array of cutters arranged with a clearance rake angle which assists the attack on the ground and the removal of the debris.

13. A drilling tool substantially as herein described with reference to the accompanying drawings.

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1592727 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

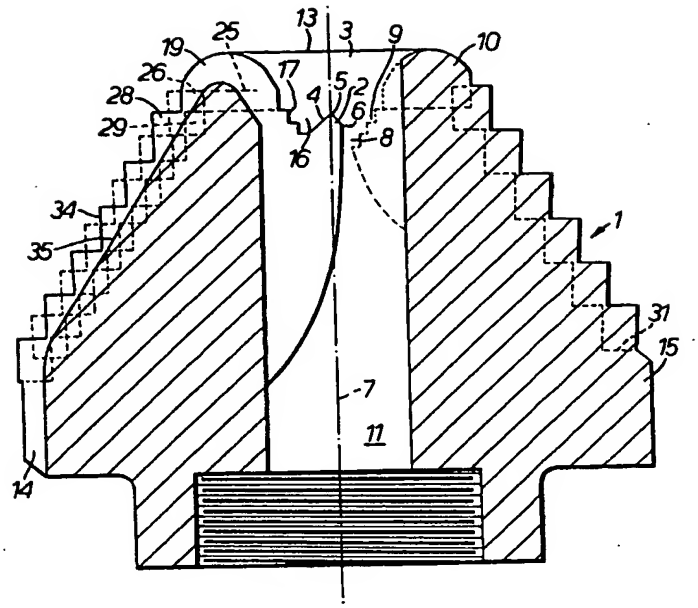

FIG. 1.

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1592727 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

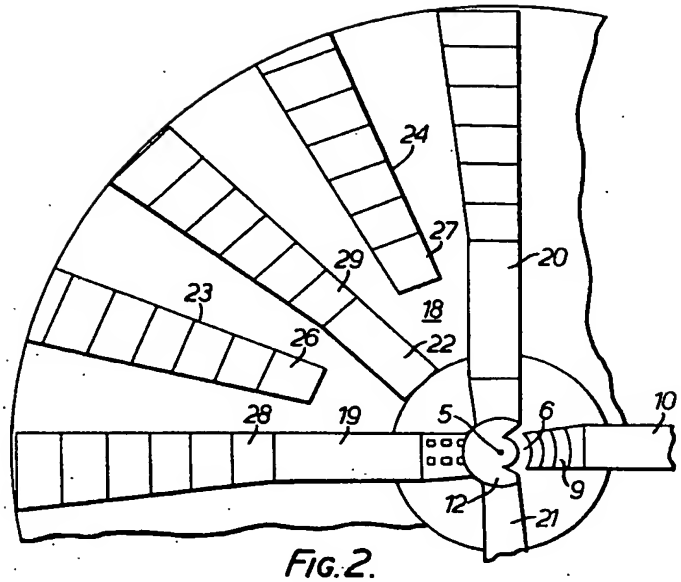

FIG. 2.

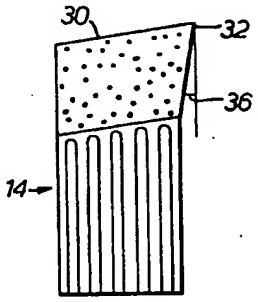

FIG. 3.